Electronic Version
Stylesheet Version v1.1.1

Claims

[c1] 1.A gas regulation system, comprising:
a manifold;
a plurality of control modules in fluid communication with the manifold, wherein each control module comprises an actuatable valve in fluid communication with an associated gas storage device; and
a power source in electrical communication with each of the actuatable valves, wherein the power source is adapted to prevent more than one of the actuatable valves from simultaneously having an actuated state.

[c2] 2.The gas regulation system of Claim 1, further comprising a directional pressure-reducing device disposed between the manifold and the control modules.

[c3] 3.The gas regulation system of Claim 1, further comprising a directional pressure-reducing device disposed between each control module and its associated gas storage device.

[c4] 4.The gas regulation system of Claim 1, further comprising an impedance safety monitor device in electrical communication with the power source.

[c5] 5.The gas regulation system of Claim 4, further comprising a shutoff disposed between the power source and the impedance safety monitor device, wherein the shutoff is responsive to interrupt a power signal from the power source.

[c6] 6.The gas regulation system of Claim 1, wherein each one of the control modules further comprises a local control-processing unit in electrical communication with a manifold controller.

[c7] 7.The gas regulation system of Claim 6, wherein the gas storage device comprises a unique identifier that can be read by the manifold controller.

[c8] 8.The gas regulation system of Claim 1, wherein each one of the control modules further comprises a housing, gas connectors, electrical connectors, and a gas storage device connector.

[c9] 9. The gas regulation system of Claim 1, wherein the actuatable valve comprises a solenoid actuated valve.

[c10] 10.The gas regulation system of Claim 1, wherein each of the actuatable valves comprises a circuit comprising a switch in electrical communication with the actuatable valve and the power source, wherein each of the circuits

are in series.

[c11] 11.The gas regulation system of Claim 1, further comprising a test module in electrical communication with the manifold controller.

[c12] 12.The gas regulation system of Claim 2, wherein the pressure reducing valve comprises a check valve adapted to provide a substantially unimpeded flow of a gas from the manifold to the control modules and to reduce a pressure of the gas flowing from the control modules to the manifold.

[c13] 13.The gas regulation system of Claim 1, further comprising an electrochemical cell system in fluid communication with the manifold, wherein the electrochemical cell system comprises a fuel cell, an electrolyzer, or both a fuel cell and an electrolyzer.

[c14] 14.The gas regulation system of Claim 10, wherein the power source is in electrical communication with a manifold controller adapted to provide operational logic to each of the circuits of the actuatable valves.

[c15] 15.The gas regulation system of Claim 1, wherein the gas is a hydrogen gas.

[c16] 16.A process for operating a gas regulation system,

wherein the gas regulation system comprises a manifold, a plurality of control modules in fluid communication with the manifold, and a power source in electrical communication with the plurality of control modules,
wherein each of the control modules comprises an actuatable valve in fluid communication with an associated gas storage device, and a circuit comprising a switch in electrical communication with the actuatable valve and the power source, the process comprising:
closing a selected one of the switches; and
energizing the circuit defined by the closed switch to open the actuatable valve, wherein energizing the circuit comprises supplying power to the circuit to enable actuation of the actuatable valve, wherein the power is insufficient to actuate the actuatable valve if more than one switch is closed.

[c17] 17.The process of Claim 16, further comprising:
opening a valve disposed between the manifold and the plurality of the control modules; and
flowing a gas between the control modules and the manifold.

[c18] 18.The process of Claim 16, further comprising:
initiating a test upon startup of the gas regulation system, wherein the test comprises commanding each one of the switches to close to provide confirmation of a

complete connection.

[c19] 19.The process of Claim 16, further comprising reducing a gas pressure flowing from the plurality of control modules to the manifold.

[c20] 20.The process of Claim 16, further comprising reducing a gas pressure flowing from the gas storage device to the control module.

[c21] 21.The process of Claim 16, further comprising monitoring the power from a power source to the circuits and interrupting the power in the event of an actionable event.

[c22] 22.The process of Claim 17, wherein the flowing a gas comprises flowing a gas from the manifold toward the control modules at a pressure of equal to or greater than about 2000 psi.

[c23] 23.The process of Claim 17, wherein the flowing a gas comprises flowing a gas from the plurality of control modules toward the manifold at a pressure of equal to or less than about 200 psi.

[c24] 24.The process of Claim 23, wherein the flowing a gas further comprises flowing a gas from one of the plurality of control modules.

[c25] 25.A control module for a gas regulation system having a manifold, the control module comprising:
a processing unit responsive to an external control signal;
an actuatable valve responsive to the processing unit and a power source, and adapted for fluid communication between a gas storage device and the manifold;
wherein the actuatable valve opens to provide fluid communication between the gas storage device and the manifold in response to a signal from the processing unit and in the absence of a second actuatable valve of a second control module of the gas regulation system being open.

[c26] 26.The control module of Claim 25, further comprising:
a switch in signal communication with the processing unit and adapted to receive power from the power source; and
an impedance device disposed between the switch and the actuatable valve;
wherein the actuatable valve is responsive to the impedance device for switching between a closed and an open position;
wherein the power from the power source is sufficient to drive no more than one impedance device to an actuatable state for opening the actuatable valve; and

wherein the actuatable valve opens to provide fluid communication between the gas storage device and the manifold in response to the impedance device being driven to the actuatable state.

[c27] 27.The control module of Claim 26, further comprising:
a first gas connector and a second gas connector, each gas connector in fluid communication with the actuatable valve, and each gas connector adapted for fluid communication with an adjacent control module; and
a first electrical connector and a second electrical connector, each electrical connector in signal communication with the processing unit, and each electrical connector adapted for signal communication with the adjacent control module;
wherein a plurality of control modules may be daisy chain connected via the gas connectors and the electrical connectors thereby providing a modular arrangement of control modules.

[c28] 28.A pressure-reducing valve for a gas regulation system, comprising:
a housing having an inflow opening and an outflow opening, wherein the inflow opening includes a seat, and the seat includes a slot; and
a flow restrictor biased toward the seat in response to gas flow in a first direction, the first direction being a

flow direction from a high pressure to a low pressure;
wherein the flow restrictor is biased away from the seat in response to gas flow in a second direction, the second direction being a flow direction from a low pressure to a high pressure;
wherein the gas flow in the first direction flows substantially through the slot.

[c29] 29.The pressure-reducing valve of Claim 28, further comprising: a spring; wherein the flow restrictor is biased in the first direction via the spring.

[c30] 30.The pressure-reducing valve of Claim 28, further comprising: a finger disposed within the housing defining a cavity thereat;
wherein the flow restrictor moves toward the cavity in response the gas flow being in the second direction.